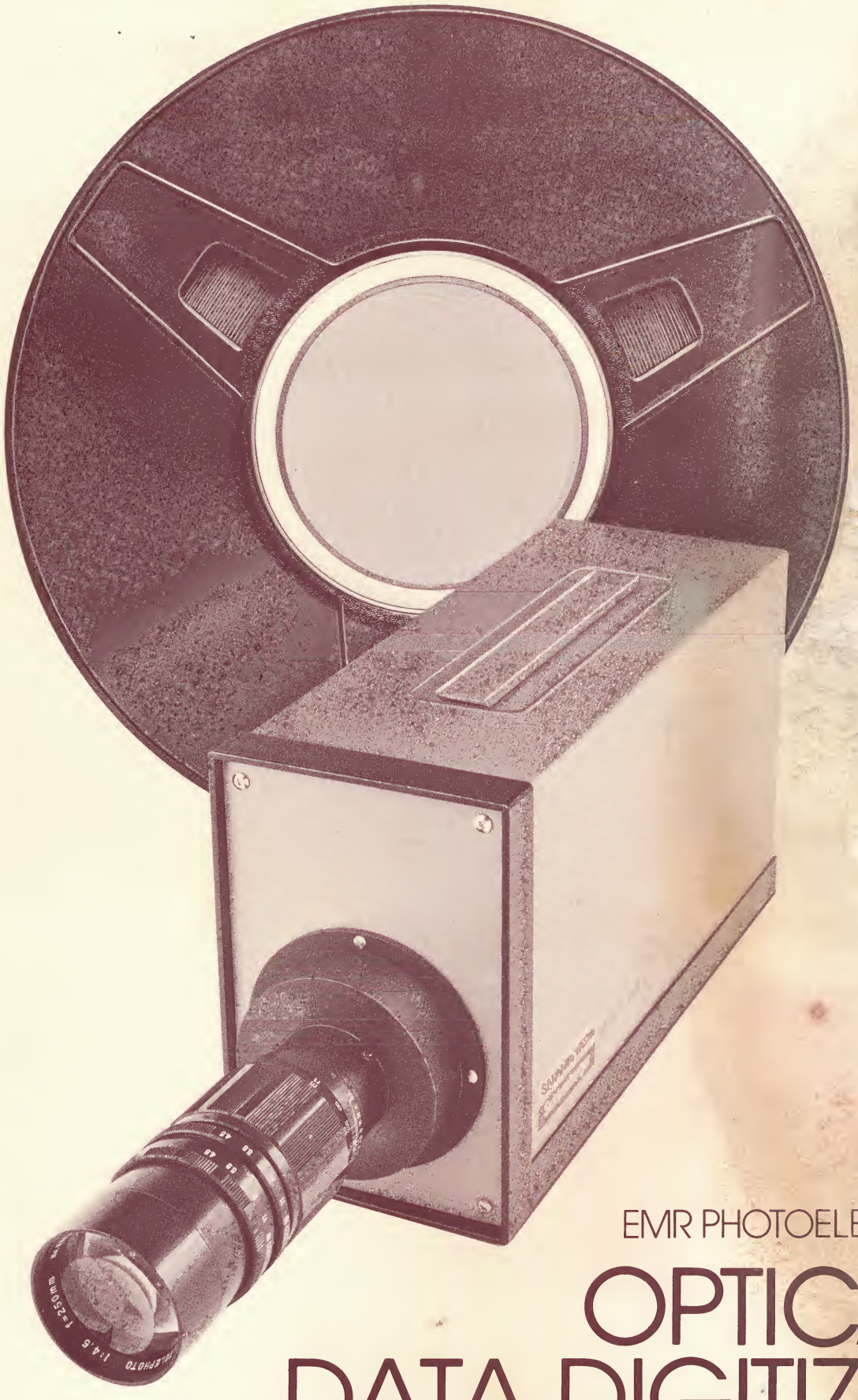
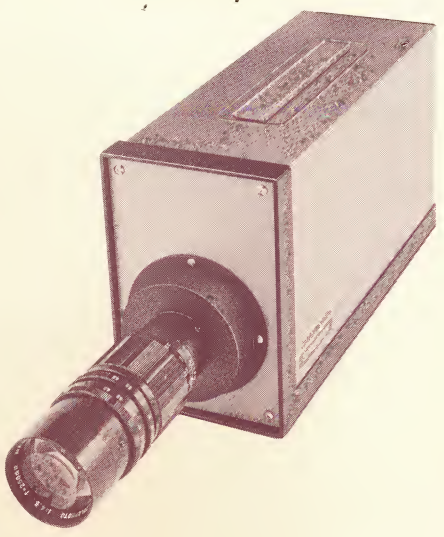
Mar 80



SANGAMO Schlumberger

EMR PHOTOELECTRIC

OPTICAL DATA DIGITIZER



MODEL 658/659 SERIES

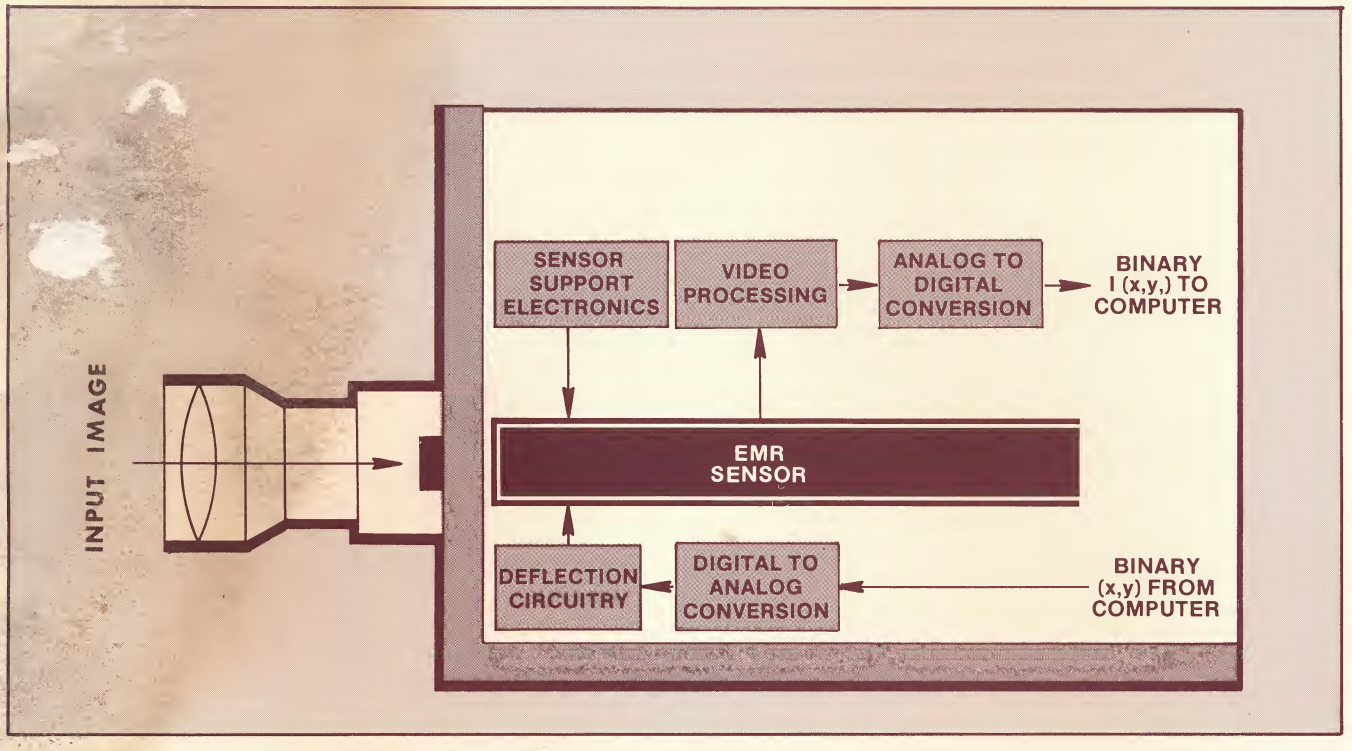
GENERAL IN. ODUCTION

Until quite recen data had to be manually or mechanically pre-processed be computer could synthesize it into meaningful information. The ne MR Optical Data Digitizer has made this off-line pre-processing a thing of the past. With the O.D.D. the computer perceives visual data on line as it determines what should be looked at and for how long.

By eliminating the pre-processing operation and by permitting the selection of pertinent input, the O.D.D. expands the service capability of the computer into visual applications whose scope is limited only by the imagination of the user and his software capabilities.

HOW THE O.D.D. WORKS

The Optical Data Digitizer creates the binary equivalent of a two-dimensional optical image and thus prepares it for immediate input into the computer. Having complete control over the O.D.D. scan along the X, Y coordinates enables the computer to select the size of each scanning step, choose the direction of the scan, determine the dwell time per element, all with random access capabilities. The computer, based on predetermined instructions, can then perform computations and initiate procedures in accordance with the kind of data it receives. It can also perform arithmetic functions such as summing, averaging over several cycles, deconvolving, or formatting for tape entry.



To accommodate the wide range of applications for which the O.D.D. can be utilized, a choice of image sensors is available and includes the highly reliable EMR Image Dissector and a number of vidicon sensors (SEC, SIT/EBS,Sb_2S_3, PbO, or Si).

The mode of converting the optical image into its electronic equivalent varies with the sensor. Using the Image Dissector, conversion takes place by scanning an electronic image emitted by a target across an aperture. Vidicon sensors, on the other hand, perform this function by holding the corresponding charge pattern on a target for subsequent read-out by an electron beam. Referring to the basic O.D.D. Block Diagram at the left, the deflection field for either type of sensor is developed from the binary X and Y address coordinates from the computer. The coordinates are converted to an equivalent analog voltage by the Digital to Analog Conversion circuitry and this voltage provides the input to the Deflection Circuitry which drives the deflection field. Intensity information, in the form of an electron charge, is detected at each addressed coordinate and prepared for conversion by the Video Processing circuitry.

The Analog to Digital Conversion circuitry then converts this voltage to an equivalent digital value for storage and processing in the computer which then prints out, displays, or formats for tape entry any pertinent information about the data determined by the software program.

BASIC PROGRAMS

EMR has designed several software programs which can be supplied to the user as a basis for his software approach to image analysis. Adaptable for specific applications, these basic programs are designed for micro-computer driving of the O.D.D. as described below:

DATA DETECTION

Basic Raster Scan. This software program allows the user to control the start and stop of the scanning raster, the raster element size, the element dwell time, the line retrace time, the frame retrace time, and exposure time.

DATA ROUTING:

Image Content Histogram. The histogram analyzes the signal level of each element of the raster and presents a display of signal-level vs. frequency occurrence (similar to pulse height analysis) on an oscilloscope or as a hardcopy printout.

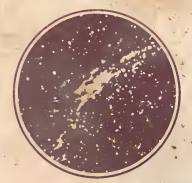
Data Output To System Console. This is a basic program which outputs any point or line of image data as viewed on the CRT to the system console (teleprinter, TV monitor, etc.). This program also allows limited resolution hard copy of the image from a teleprinter by using ASCII or graphics characters.

Data Output From Computer To Scan Converter. This basic program provides computer control of the intensity data for writing computer modified images to a scan converter (requires hardware interface).

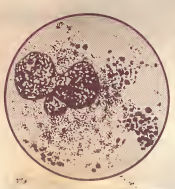
APPLICATIONS OF THE O.D.D. SYSTEM

Because of the operational simplicity and versatility of both its mechanical configuration and its software programs, the O.D.D. system can be used in almost any application requiring the high-speed conversion for optical data for entry into a digital computer. Limited only by the imagination of the user and his total software capabilities, the O.D.D. system can be used in countless applications, of which this is a small sampling:

Astronomy. The field of astronomy is replete with data-gathering requirements which are compatible with O.D.D. capabilities. The O.D.D. can be used as a very accurate stellar-aspect sensor, with the added capability of tracking moving targets in the field of view. Stellar and solar spectroscopy, mapping of star fields, and comparisons with previous photographic plates are natural uses of the O.D.D. in this application, along with real-time solar magnetography and numerous related tasks involved in earth satellite programs.



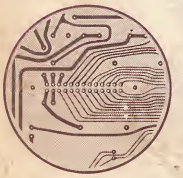
Medical Biochemical Analysis. In the field of cell analysis and classification among the multitude of medical applications, the O.D.D. system can make rapid diagnostics possible. The classification of thousands of different biological anomalies can be made and stored for instant comparison and retrieval. In fact, any sort of interpretation of visual biochemical data can be handled by the O.D.D. system with its computer interface as long as comparative data is available from computer memory



Photographic Interpretation. Since rapid analysis and interpretation of photographic images is possible, satellite or other remote TV signals can be interpreted in real time by the O.D.D. system for immediate command-control decisions. The computer can be programmed to recognize certain patterns and call them to the attention of concerned personnel, or it can merely catalog identified items.

Spectroscopy. Spectroscopy involves the use of various optical elements to break a luminous source (either natural or artificial) into its component wavelengths, which can then be imaged according to position (or both position and intensity) in a two-dimensional array. The O.D.D. can accept such inputs and enable the computer to classify the spectral image by comparison with previously stored information at rates far in excess of manual or electromechanical methods. This technique could lend itself to real-time process control of critical metallurgical or chemical processes.

Inspection/Quality Control/Dimensional Analysis. The computerization of the quality control function in a production operation represents one of the most significant potential applications for the O.D.D. system. In the metals industry, the O.D.D. system can be used for real-time inspection of products such as sheet and strip materials. Spectrochemical analysis can be performed on in-process materials in both the metals and chemical industries. Visual chip-disconnects can be seen almost instantly in the semi-conductor and integrated circuit industries during in-process inspections.



Criminology. Besides the previously discussed spectroscopy and cell analysis, the most readily apparent use of the O.D.D. system in criminology is in the area of fingerprint analysis and identification. Other applications, such as photograph identification of wanted criminals, depend only on the state-of-the-art of software programs.

OPTICAL DATA DIGITIZER COMPOSITE DATA

(Letters in Parentheses refer to Notes on Bottom)

MODEL	658A	659A	659B	659F
Optics	SPECIFIED OR PROVIDED BY USER			
Sensor	EMR Model 575 Image Dissector	Model 4532 Silicon Vidicon	Type 4804 Silicon Intensified Vidicon	Type 30893 SEC Vidicon
Input Window	7056 Glass flat, .080" (2.03mm) thick or fiber optic	7056 Glass flat, .094" (2.39mm) thick	Fiber Optic flat	Fiber Optic flat
Input Image Size	28mm x 28mm (43 diagonal)	11mm x 11mm (16mm diagonal)	11mm x 11mm (16mm diagonal)	17mm x 17mm (25mm diagonal)
Required Sensor Illumination in FCS	5 to 50 footcandles	7×10^{-3}FCS at knee, 3×10^{-5}FCS at threshold (a)	6×10^{-5}FCS at knee, 3×10^{-8}FCS at threshold (a)	10^{-4}FCS at knee, 10^{-6}FCS at threshold (a)
Signal Transfer Function	Unity gamma throughout range	Approximately unity gamma	Approximately unity gamma	Approximately unity gamma
Uniformity (90% area)	±20%, will not vary more than 2%/mm.	±10%	±15%	±15%
Exposure Time	Software Controlled	15ms to 1 sec, software controlled. Maximum time limited by dark current which will destroy any an uncooled image within 3 seconds. Controlled by optional shutter (15ms-1 sec) or frame time in continuous sweep mode (b)	15ms to 1 sec, software controlled. Maximum limited by dark current which will destroy an uncooled image within 3 seconds.	Software controlled. 15 ms to 60 seconds standard, 5 hours maximum.
Maximum Readout Time	Software Controlled	Software controlled. 1 sec max with uncooled sensor.	Software controlled. 1 sec max with uncooled sensor.	Software controlled, 1 hour maximum.
Dark Current in electrons/sec/cm² at 20°C.	10^3	3×10^{10}	3×10^{10}	10^3
Sensor Modulation Transfer Function	20 lp/mm @ 50%; 40 lp/mm limiting (with .075" aperture).	18 lp/mm @ 50%, 40 lp/mm limiting	14 lp/mm @ 50%, 32 lp/mm limiting	9 lp/mm @ 50%, 20 lp/mm limiting
Commandable Data Points (12-bit Digital to Analog Converter Standard)	4096X by 4096Y	4096X by 4096Y	4096X by 4096Y	4096X by 4096Y
Resolvable Data Points	2048X by 2048Y (c)	512X by 512Y	512X by 512Y	512X by 512Y
Addressing Accuracy				
Static	0.5%	1%	3%	3%
Repeatability	0.03%	0.1%	0.1%	0.1%
Addressing Time				
Small step (d)	2 μs	2 μs	2 μs	2 μs
Full Scale Step (e)	30 μs	30 μs	30 μs	30 μs
Speed	Total processing time per element is software controlled. For small steps, 50 μs per element is typical.	Total processing time per element is software controlled. For small steps, 50 μs per element is typical.	Total processing time per element is software controlled. For small steps, 50 μs per element is typical.	Total processing time per element is software controlled. For small steps, 50 μs per element is typical.
Minimum Access Time per Element (Not including address or program time)	4 μs	7 μs	7 μs	7 μs
Encoder Output Intensity Levels (8-bit, 4 μs ADC Standard)	256	256	256	256
Maximum Signal-to-Noise Ratio (f)	$1.22\ d\sqrt{E\Delta t}$ (g)	500:1	40:1	50:1
Computer (h)	SPECIFIED OR PROVIDED BY USER			

OPTIONS

Model 658A, 659A, B, F

1. Precision Yoke
2. 10-bit, 4 μs ADC (8-bit, 4 μs standard)
3. 12-bit, 4 μs ADC
4. 8-bit, 2.4 μs ADC

Model 659A, B, F

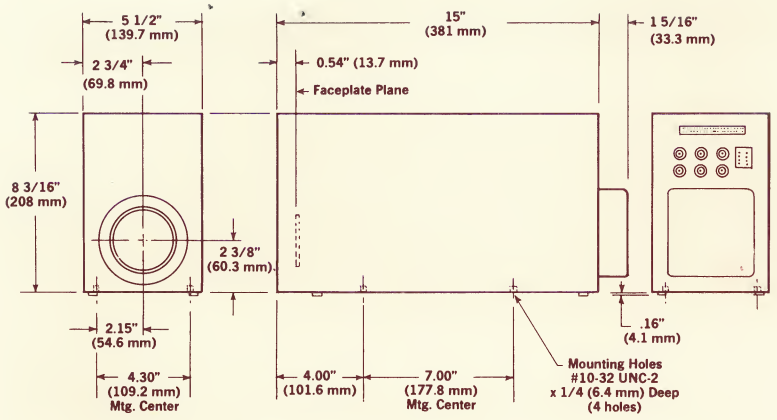
1. 30 frames/second internal computer selected sweep generator for setup and target recharge (5 f/s standard)
2. 10-bit, 4 μs ADC (8-bit, 4 μs standard)
3. Geometric Distortion correction to 0.5% (658 and 659F only).

MODIFICATIONS

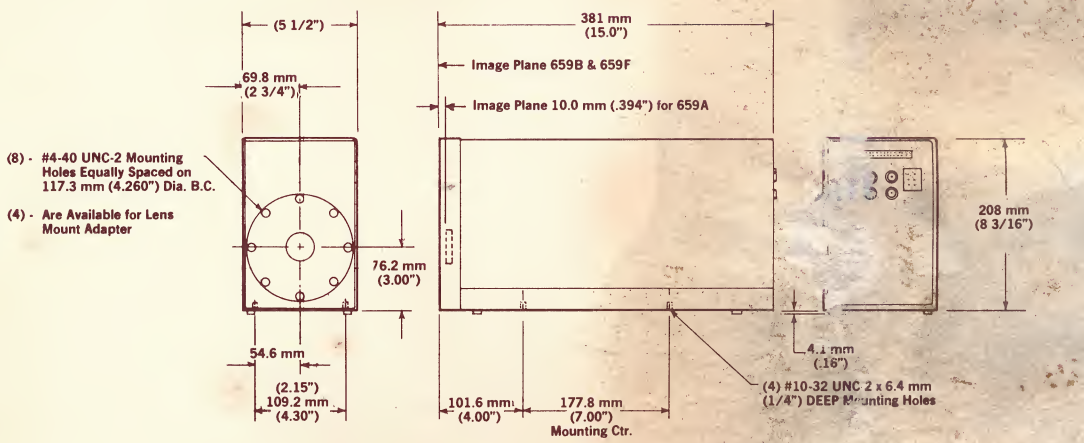
1. Cooling for silicon vidicons
2. Coupled image intensifiers
3. X,Y monitors
4. Tape or disc storage.

NOTES

a. Footcandle seconds
b. May be extended to 300 seconds with cooling modification.
c. At 5% MTF.
d. Time required to move or deflect through 95% of address step across 1% of total field width.
e. Time required to move or deflect through 95% of address step across 50% of total field width.
f. Dependent upon number of quantum events per exposure time. Varies directly as a product of exposure time and intensity. The video preamplifier contributes 1,000 electrons of uncertainty per sample.
g. d = aperture diameter in mils; E = faceplace illumination; foot candles; Δ t = elemental dwell time in microseconds.
h. A 16-line input/output interface can be provided as an option to interface with 16-line interface from the computer.



OUTLINE DRAWING—MODEL 658 A



OUTLINE DRAWING FOR 659 A, B, F

WEIGHT: 20 lbs.

POWER:

658A ±15V dc @ 2A, +5V dc @ 1A

659 Series: ±15V dc @ 1A, +5V dc @ 1A, -6V dc @ 1A

POWER SUPPLY: Optional and separate from the O.D.D. Model 635B (enclosure) or 635D (rackmount).

658A and 659 Series: Both supplies operate from jumper selectable 115 VAC-60 Hz/230VAC-50 Hz
Enclosure supplies are the same case size as the O.D.D.

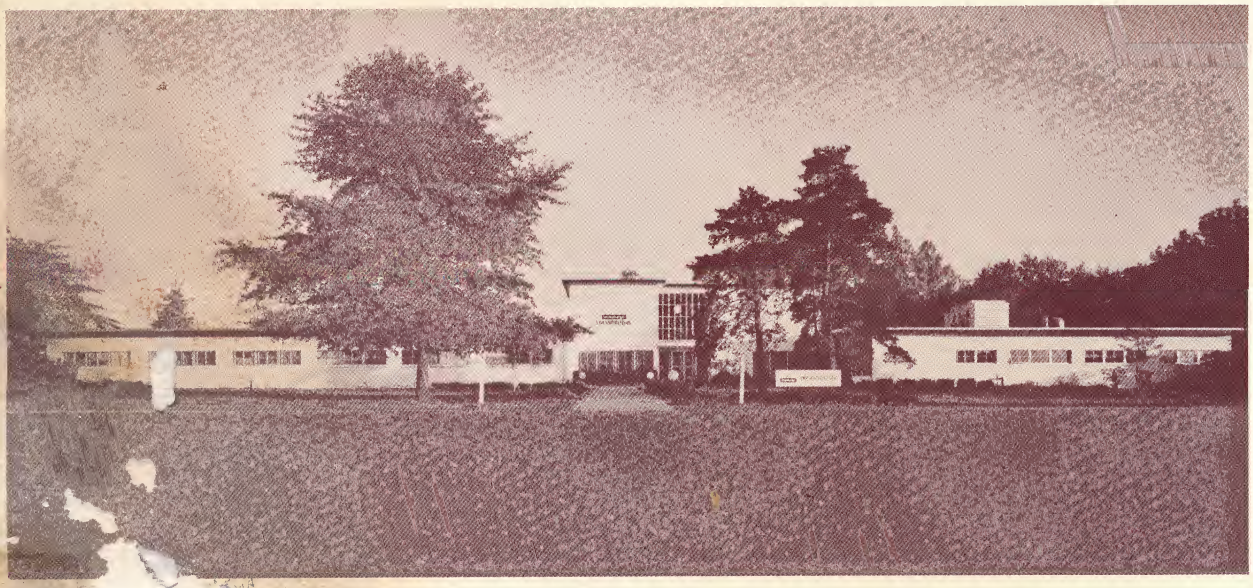
COMPUTER: The use of a computer to set the scanning format allows the user an infinite number of variations which is obtainable in no other manner. These variations include direction of scan, size of scanning step, random access, dwell time per element change, and in the 658A only, computer selected variable bandwidths of 100Hz, 1kHz, 10kHz, and 100kHz. The computer provides the ability to perform computations from the data as it is generated. These computations may take the form of averaging over several cycles in order to obtain accuracy, deconvolving, or performing arithmetic functions such as summing, etc.

Only about 200 words are used in the scanning program; therefore, many words are available for use in programs.

WARRANTY (Brief Statement)

EMR warrants its products to be free from defects in workmanship and material for 90 days from the date of shipment. Major components manufactured by others (e.g., electronic sub-assemblies and electronic tubes) included in EMR products and systems are warranted to the extent provided by their manufacturer.

EMR PHOTOELECTRIC



EMR PHOTOELECTRIC is a Division of Sangamo Weston, Inc., a subsidiary of Schlumberger Limited. Schlumberger Limited, founded in 1926, is headquartered in New York and is comprised of subsidiaries and divisions spread throughout the world. Preeminent in the oil well logging business, Schlumberger has grown to be a world-wide financial and technological leader. Diversification has accompanied growth in sales and financial strength. Products and services range from a wide variety of electronic instruments to complete oil field services. Concentration in areas of high technology makes the company unusually well prepared for continued growth. EMR PHOTOELECTRIC fits well into the business matrix of Schlumberger Limited, whose stability, vast financial resources, interest in technological leadership and commitment to the national interest it shares.

A leader in advanced research and technology in electro-optics, EMR PHOTOELECTRIC has created a product line consisting of many items that are unique and unavailable from any other source. Since 1960, it has been successfully engaged in the design, manufacture and marketing of extremely high performance photoelectric devices such as multiplier phototubes, photodiodes, electron multipliers, special purpose imaging tubes, image dissectors and ultraviolet calibration devices. Additional product lines include multiplier phototube power supplies, digital video camera systems, non-contact inspection systems, and character recognition systems.

EMR PHOTOELECTRIC maintains a vigorous system of quality control to ensure product performance and reliability. All critical materials are procured from reliable vendors; highly trained operators are employed to perform all manufacturing functions, and qualified inspectors examine each process for standards conformance. Test instrument calibration is traceable to the National Bureau of Standards. Quality Assurance and Reliability controls are consistent with NASA NHB5300, MIL-Q-9858A, and MIL-STD 810B requirements.

At EMR PHOTOELECTRIC, all land, buildings, machinery and equipment are company owned. Financial management is well planned, conservative, and consistent with generally accepted accounting practices and Government Procurement regulations. Investment capital, working capital, and other financial assistance are supplied by the parent company.

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